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EXAMINER	
SAXENA, AKASH	
ART UNIT	**PAPER NUMBER**
2128	

NOTIFICATION DATE	DELIVERY MODE
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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

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Office Action Summary	Application No. 10/809,276	Applicant(s) CENTALA ET AL.	
	Examiner AKASH SAXENA	Art Unit 2128	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *16 December 2009*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *2-9,11-23,25-38,40,45 and 46* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *2-9,11-23,25-38,40,45 and 46* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

1. Claims 2-9, 11-23, 25-38, 40, and 45-46 have been presented for examination based on applicant's preliminary amendment of 12/16/2009.
2. Claims 2-9, 11-23, 25-38, 40, and 45-46 remain are rejected under 35 USC 103.
3. Heading for claim 11 is corrected.
4. This action is made Final.

Response to Claim Rejections - 35 USC § 103

(Argument 1) Applicant has argued in Remarks Pg.4-6:

> Initially, Applicant notes that both independent claims 45 and 46 require, in part, adjusting at least one parameter of the selected drill bit based on the generated ratio until the magnitude of the radial forces is less than a predetermined value for a preselected time for a simulated drilling. The Examiner asserts that the limitation "for a preselected time" is taught by Glass, Figure 3A because "the window is the selected time period for the simulation where the torque is expressed as the percentage less than certain (sic) amount associated with the radial forces." Office Action dated September 16, 2009 ("Office Action"), pages 9 and 12. <u>However, Applicant notes that the Examiner's description of Figure 3A (quoted above) actually does not disclose or suggest the required element of" a preselected time" as required by claims 45 and 46,</u> as discussed below. Figure 3A is reproduced below:
> …
>
> Contrary to the Examiner's assertion, <u>there is no teaching or suggestion that the particular timeframe shown in Figure 3A is comparable to a **preselected time**.</u> Rather, Figure 3A and its associated text teaches only that a simulation is run, <u>during which time necessarily passes</u>. **[1]** By asserting that a preselected time is the same as a certain amount of time passing, the Examiner is removing this element from the context of the claims. Independent claims 45 and 46 require, in part, methods that include a step of adjusting a parameter to determine when a variable (e.g., the magnitude of the radial forces) is less than a predetermined value <u>for that preselected time</u>. <u>**Glass merely teaches that an iteration is run for a particular time**</u>.

(Response 1) First applicant has not specified any metes and bounds for the "pre-selected time" therefore the claim as presented is interpreted broadly as <u>*any time or time frame*</u>. Further applicant has admitted in their own arguments that the iteration is run for the "particular time", which is a time frame. Further Glass teaches a time as well as time frame (See the box in Fig.3A from iteration 49-67 representing simulation time for the revolutions). Applicant admits in [1] that time passes during

these boxed simulation cycle and therefore Glass teaches the limitation of preselected time.

(Argument 2) Applicant has argued in Remarks Pg.6:

> Applicants admit that Figure 3A shows that the passage of time necessarily occurs during any iteration of a simulation being run. <u>However, this abstract sense of time does not teach or suggest a method step that includes the determination of when a variable is less than a predetermined value for a preselected time.</u>

(Response 2) Again it is admitted by applicant that the simulation time passes for each simulated revolution as presented in Fig.3A. Selecting or preselecting a simulation time would represent selecting a point in the simulation which would map to the revolutions that have happened by then. Applicant's arguments are therefore not persuasive.

(Argument 2) Applicant has argued in Remarks Pg.7:

> The Examiner also indicates that, "so long as [a reconstruction based upon hindsight reasoning] takes into account only knowledge which was within the level of ordinary skill at the time the claimed invention was made, and does not include knowledge gleaned only from the applicant's disclosure, such a reconstruction is proper." Office Action, page 7 (citing In re McLaughlin, 443 F.2d 1392, 170 USPQ 209 (CCPA 1971). However, the claimed invention would not have been obvious to a person of ordinary skill in the art at the time of invention based on such a person's knowledge at the time and the disclosure of Glass. <u>At the time the present invention was made, simulations were conventionally performed to collect measurements on certain variables</u> **[1]** (e.g., the Amoco models relied on by Glass). In contrast, the presently claimed invention innovatively <u>requires adjusting at least one parameter of the selected drill bit based on the generated ratio until the magnitude of the radial forces is less than a predetermined valu</u>e for a preselected time for a simulated drilling.

(Response 2) Applicant has merely alleged with cursory statement (see [1]) that the invention would not have been obvious without any rationale having support for it. Glass is clearly modifying the design (Fig.1 & 3 A-B with associated disclosure) based on the simulation. Specifically Glass teaches the limitation, "***adjusting at least one parameter of the selected drill bit based on the generated ratio until the magnitude of the radial forces is less than a predetermined value***" (Glass: Fig3A - where the torque is expressed as the percentage less than certain amount

associated with the radial forces; *Also See Col.5 Lines 24-34*) ***for a pre-selected time*** (Glass: Fig.3A pre-selected simulation time represented by pre-selected simulated revolutions 49-63), ***for a simulated drilling*** (Glass: Fig.1 Step 110).

(Argument 3) Applicant has argued in Remarks Pg.8:

> Applicant also notes that the invention as a whole must be considered in an obviousness determination. The "invention as a whole embraces the structure, its properties, and the problem is solves." In re Wright, 848 F.2d 1216 (Fed. Cir. 1988). .... Examiner must consider the invention as a whole, i.e., the entire disclosure of Glass, while not merely focusing on whether it would be obvious to select a time from a timeline. <u>As the Examiner in this case has simply indicated that the time axis in Figure 3A of Glass may be analogous to having a "preselected time," the Examiner has improperly focused on a substitution, rather than on the invention as a whole.</u> The specification of Glass provides no support for a reading of Figure 3A to the contrary of the reading submitted by the Applicant.

(Response 3) Again, applicant has admitted that simulation time must pass as the simulation of the figure 3A progresses. Pre-selecting a revolution block (revolution from 46 to 63) or a specific revolution must happen at a specific time in simulation, therefore amounts to selecting a simulation time/time frame. Examiner respectfully disagrees with the applicant as they seem to incorrectly arguing improper substitution. Further, applicant has not provided any evidence contrary to their statement (Argument 1 [1] - Rather, Figure 3A and its associated text teaches only that a simulation is run, <u>during which time necessarily passes</u>. **[1]**). Unless the time does not pass during the simulation as presented in Fig3A, Glass appears to teach the claimed limitation.

(Argument 4) Applicant has argued in Remarks Pg.8-9:

> …The Supreme Court in KSR noted that the analysis supporting a rejection under 35 U.S.C. § 103 should be made explicit. " Further, when combining prior art elements, the Examiner "must articulate the following: (1) a finding that the prior art included each element claimed, although not necessarily in a single prior art reference, with the only difference between the claimed invention and the prior art being the lack of actual combination of the elements in a single prior art reference .... " MPEP § 2143(A). <u>Thus, the proper legal test for obviousness does not involve extrapolation.</u>

(Response 4) Examiner clearly address each claimed limitations taught by combination of prior art of references.

(Argument 5) Applicant has argued in Remarks Pg.9-10:

> **[1]** Still further, the Examiner asserts that "[e]ven is (sic) Ma and Glass are presumed not to explicitly teach outputting a drill bit design on the generated ratio between the WOB... …
> … In fact, Glass is silent with respect to the ratio. … Glass does not teach adjusting design parameters based on a ratio between radial forces and weight on bit to obtain a design, as required in part by claims 45 and 46.
>
> **[2]** Ma and Beaton do not provide that which Glass lacks. There is no teaching or suggestion in Ma or Beaton to adjust at least one parameter of the selected drill bit based on the generated ratio until the magnitude of the radial forces is less than a predetermined value for a preselected time for a simulated drilling, as required by the claimed invention. Independent claims 45 and 46 are patentable over Ma, Glass, and Beaton, considered alone or in combination. Dependent claims are patentable for at least the same reason. Therefore, withdrawal of this rejection is respectfully requested.

(Response 5) In response to applicant's arguments against the references individually, one cannot show nonobviousness by attacking references individually where the rejections are based on combinations of references. See *In re Keller*, 642 F.2d 413, 208 USPQ 871 (CCPA 1981); *In re Merck & Co.,* 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986). As per [1] Beaton teaches ratios in [0034]. As per [2], Glass teaches limitation pertaining to pre-selected time.

(Argument 6) Applicant has argued in Remarks Pg.10-11:

> Turning to the rejection of claims 8 and 9 **[sic – claim 11]** over Ma, Glass, Beaton, and Beaton2, this rejection is respectfully traversed. Beaton2 discloses bi-center bits designed such that the imbalance forces that result from the cutting action of the reaming cutters are offset by forces resulting from the cutting action of the remaining cutters so that the overall total of the imbalance forces on the bit is minimized. (Beaton2, col. 3, lines 35-41). Beaton2 does not provide that which Ma, Glass, and Beatori lack. More specifically, Beaton2 does not teach or suggest adjusting a parameter based on a generated ratio until the magnitude of the radial forces (or generated ratio) is less than a predetermined value for a preselected amount of time, as required in part independent claims 45 and 46. Therefore, independent claims 45 and 46, are patentable over Ma, Glass, Beaton, and Beaton2, whether considered separately or in combination. Dependent claims, including claims 8-9 [sic – claim 11], are allowable for at least the same reasons. Thus, withdrawal of this rejection is respectfully requested.
>
> Turning to the rejection of claims 8 and 9 over Ma, Glass, Beaton, and Warren, this rejection is respectfully traversed….

(Response 6) *Applicant has merely alleged that Beaton2 does not teach the limitation. . Examiner respectfully maintains the rejection for claim 11 and 8-9 for at least following reasons:* Beaton2 teaches the ratio of the sum of the radial forces to the applied weight on bit is less than or equal to 0.20 (Beaton2: Col.3 Lines 7-11), whereas aspect relating to adjusting the ratio is taught as .
[explain how Beaton 2 teach "adjusting a parameter based on a generated ratio.....for a preselected amount of time."].

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Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

5. **Claims 2-7, 14-23 and 25-38 are and 45-48 are rejected under 35 U.S.C. 103(a) as being unpatentable over "The Operational Mechanics of The Rock Bit", <u>Ma</u> et al, Petroleum Industry Press, Copyright 1996, further in view of U.S. Patent 6695073 issued to <u>Glass</u> et al, further in view of US PGPUB 20010020552 A1 by Beaton et al.**

The Ma reference is a study of the dynamics of the interaction between the roller cone drill bit and rock (earth) including bit geometry, kinematics, axial loading, and the balancing (equalization) of forces acting on a roller cone drill bit. In particular, Chapter 6, and to some degree Chapter 5, of Ma sets forth the elements of what he refers to as the "New Methodology" for roller cone bit design. This "New Methodology" includes the use of drilling simulation and computer modeling for optimizing the parameters relating to the design of new roller cone drill bits. (See: page 1, paragraph 2, for condensed overview).

The examiner submits that the teachings of Ma render obvious the claimed limitations of the instant invention as presently claimed as follows:

Regarding independent claim 45 (Updated 9/10/09): *A method for designing a drill bit, comprising:*

- determining radial forces acting on a selected drill bit during simulated drilling; (6.1, 6.1.2.3, 5.3, 3.3 - 3.5, Ma discloses drilling simulation, forces acting on roller cones at least at pages 128, 129, section 5.1)

- evaluating the radial forces based on at least one selected criterion; (Ma teaches forces acting on roller cones at least at pages 128, 129, section 5.1, which would be an inherent part of optimizing the 3-D load model using finite element analysis disclosed in sections 6.1-6.2.3 of Ma. (especially, 6.1.1.5))

- wherein evaluating comprises summing magnitudes of the radial forces with respect to a direction to, generate a sum of the radial forces is a limitation not explicitly taught by Ma and is taught by Glass (Glass: Col.4 Lines 27-56)*;*

- comparing the sum of the radial forces to an applied weight-on-bit is a limitation not explicitly taught by Ma and is taught by Glass (Glass: Col.4 Lines 47-56)*; and*

- generating a ratio between the sum of the radial forces and the applied weight-on-bit is a limitation not explicitly taught by Ma and is taught by Glass (Glass: Col.4 Lines 47-56);

- adjusting at least one parameter of the selected drill bit based on the evaluating; (Ma: 6.1, 6.1.1.1, 6.1.2.3, page 232, lines 6-11, Ma sets forth adjusting design parameters; Glass: Col.4 Line 58-Col.5 Line 11) until the magnitude of the radial forces is less than a predetermined value for a preselected amount of time for a simulated drilling as seen in the Fig.3 A (at least) where the window is the selected

time period for the simulation where the torque is expressed as the percentage less than certain amount associated with the radial forces.

It would have been obvious to a skilled artisan having access to the teachings Ma at the time of the invention to combine Ma and Glass as both of them are directed towards modeling the drill bit and computing forces which is also a deficiency in Ma explicitly taught by Glass disclosing programmed calculations of summed orthogonal cutter forces inclusive of weight-on-bit. (CL4-L27-46). Further the motivation to combine is defined by the current state of the prior art - i.e. teaching of Glass where it admits the force distribution can be optimized for either roller cone or PDC drill bit the similar way (Glass Col.7 Lines 11-14).

Glass teaches adjusting at least one parameter (Glass Col.5 Lines 8-24) of the selected drill bit based on the generated ratio (WOB and Torque) and outputting a drill bit design based on the generated ratio and the adjusting.

Even is Ma and Glass are presumed not to explicitly teach outputting a drill bit design based on the generated ratio between the WOB (Fy component in Glass) and radial forces (Fx and Fz force components in Glass) to modify, such suggestion is clearly present in Glass Col.5 Lines 8-24.

Beaton explicitly teaches outputting a drill bit design based on the generated ratio between the WOB in [0035] as:

> [0034] **In another aspect of the invention, it has been determined that the drilling stability of a bi-center bit can be further improved by force balancing the entire bit 10 as a single structure**. Force balancing is described, for example, in, T. M. Warren et al, Drag Bit Performance Modeling, paper no. 15617, Society of Petroleum Engineers, Richardson, Tex., 1986. Prior art bi-center bits were force balanced, but in a different way. **In this embodiment of the invention the forces exerted by each PDC cutters 12 can be calculated individually, and the locations of the blades and the PDC cutter 12 thereon can be selected so that the sum of all the forces exerted by each of the cutters 12 will have a net imbalance of less than about 10 percent of the total axial force exerted on the bit (known in the art as the "weight on bit").** The designs of both the pilot section 13 and the reaming section 15 are optimized simultaneously in this aspect of the invention to result in the preferred force balance.

> **An improvement to drilling stability can result from force balancing according to this aspect of the invention because the directional components of the forces exerted by each individual cutter 12 are accounted for.** In the prior art, some directional force components, which although summed to the net lateral force exerted individually by the reaming section and pilot section, can result in large unexpected side forces when the individual cutter forces are summed in the aggregate in one section of the bit to offset the aggregate force exerted by the other section of the bit. **This aspect of the invention avoids this potential problem of large unexpected side forces by providing that the locations of and shapes of the blades 14, 1 and cutters 12 are such that the sum of the forces exerted by all of the PDC cutters 12, irrespective of whether they are in the pilot section 13 or in the reaming section 15, is less than about 10 percent of the weight on bit.** It has been determined that still further improvement to the performance of the bit 10 can be obtained by balancing the forces to within 5 percent of the axial force on the bit 10.

It would have been obvious to a skilled artisan having access to the teachings Ma at the time of the invention to combine <u>Beaton and Glass</u> as Beaton cures the recognized deficiency in Glass of force balancing the entire PDC drill bit (Beaton: [0034]; Glass: Col.5 Lines 8-24) thereby increasing the stability of bi-center drill bit.

<u>Regarding independent claim 46 (Updated 9/10/09)</u>: *A method for designing a bottom hole assembly, comprising:*

- determining radial forces acting on a bottom hole assembly during simulated drilling, said bottom hole assembly including a drill bit. (6.1, 6.1.2.3, 5.3, 3.3 - 3.5, Ma discloses drilling simulation, forces acting on roller cones at least at pages 128, 129, section 5.1, and a bottom pattern modeling at least in Figures 5-20 to 5-32)

- evaluating the radial forces based on at least one selected criterion; (Ma teaches forces acting on roller cones at least at pages 128, 129, section 5.1, which would be an inherent part of optimizing the 3-D load model using finite element analysis disclosed in sections 6.1-6.2.3 of Ma. (especially, 6.1.1.5))

- wherein evaluating comprises summing magnitudes of the radial forces with respect to a direction to, generate a sum of the radial forces is a limitation not explicitly taught by Ma and is taught by Glass (Glass: Col.4 Lines 27-56)*;*

- *comparing the sum of the radial forces to an applied weight-on-bit* is a limitation not explicitly taught by Ma and is taught by Glass (Glass: Col.4 Lines 47-56)*; and*

- *generating a ratio between the sum of the radial forces and the applied weight-on-bit* is a limitation not explicitly taught by Ma and is taught by Glass (Glass: Col.4 Lines 47-56);

- adjusting at least one parameter of the bottom hole assembly based on the evaluation (6.1, 6.1.1.1, 6.1.2.3, page 232, lines 6-11, Ma sets forth adjusting design parameters *Glass: Col.4 Line 58-Col.5 Line 11)* *until the magnitude of the radial forces is less than a predetermined value for a preselected amount of time for a simulated drilling* as seen in the Fig.3 A (at least) where the window is the selected time period for the simulation where the torque is expressed as the percentage less than certain amount associated with the radial forces.

Hence, it would have been obvious to a skilled artisan having access to the teachings Ma at the time of the invention to realize the elements of the present invention as currently claimed. An obvious motivation exists since Ma teaches that the elements as claimed, and noted above, can be combined in order to find an optimum design and avoid bit (breakage) failure (chapter 6, section 5.4, especially page 232, based on the entire teaching).

It would have been obvious to a skilled artisan having access to the teachings Ma at the time of the invention to combine Ma and Glass as both of them are directed towards modeling the drill bit and computing forces which is also a deficiency in Ma explicitly taught by Glass disclosing programmed calculations of summed orthogonal cutter forces inclusive of weight-on-bit. (CL4-L27-46). Further, the motivation to combine is defined by the current state of the prior art - i.e.

teaching of Glass where it admits the force distribution can be optimized for either roller cone or PDC drill bit the similar way (Glass Col.7 Lines 11-14).

Glass teaches adjusting at least one parameter (Glass Col.5 Lines 8-24) of the selected drill bit based on the generated ratio (WOB and Torque) and outputting a drill bit design based on the generated ratio and the adjusting.

Even is Ma and Glass are presumed not to explicitly teach outputting a drill bit design based on the generated ratio between the WOB (Fy component in Glass) and radial forces (Fx and Fz force components in Glass) to modify, such suggestion is clearly present in Glass Col.5 Lines 8-24.

Beaton explicitly teaches outputting a drill bit design based on the generated ratio between the WOB in [0035] as:

> [0034] **In another aspect of the invention, it has been determined that the drilling stability of a bi-center bit can be further improved by force balancing the entire bit 10 as a single structure**. Force balancing is described, for example, in, T. M. Warren et al, Drag Bit Performance Modeling, paper no. 15617, Society of Petroleum Engineers, Richardson, Tex., 1986. Prior art bi-center bits were force balanced, but in a different way. **In this embodiment of the invention the forces exerted by each PDC cutters 12 can be calculated individually, and the locations of the blades and the PDC cutter 12 thereon can be selected so that the sum of all the forces exerted by each of the cutters 12 will have a net imbalance of less than about 10 percent of the total axial force exerted on the bit (known in the art as the "weight on bit").** The designs of both the pilot section 13 and the reaming section 15 are optimized simultaneously in this aspect of the invention to result in the preferred force balance. **An improvement to drilling stability can result from force balancing according to this aspect of the invention because the directional components of the forces exerted by each individual cutter 12 are accounted for.** In the prior art, some directional force components, which although summed to the net lateral force exerted individually by the reaming section and pilot section, can result in large unexpected side forces when the individual cutter forces are summed in the aggregate in one section of the bit to offset the aggregate force exerted by the other section of the bit. **This aspect of the invention avoids this potential problem of large unexpected side forces by providing that the locations of and shapes of the blades 14, 1 and cutters 12 are such that the sum of the forces exerted by all of the PDC cutters 12, irrespective of whether they are in the pilot section 13 or in the reaming section 15, is less than about 10 percent of the weight on bit.** It has been determined that still further improvement to the performance of the bit 10 can be obtained by balancing the forces to within 5 percent of the axial force on the bit 10.

It would have been obvious to a skilled artisan having access to the teachings Ma at the time of the invention to combine Beaton and Glass as Beaton cures the

recognized deficiency in Glass of force balancing the entire PDC drill bit (Beaton: [0034]; Glass: Col.5 Lines 8-24) thereby increasing the stability of bi-center drill bit.

Per claims 2-7: *Ma renders obvious elements relating to performance parameters and cutting element interaction of a roller cone bit as noted above (6.1, 6.1.1.1, 6.1.2.3, page 232, lines 6-11)*

Per claims 12-13

Beaton teaches the ratio of the sum of the radial forces to the applied weight on bit is less than or equal to 0.10 or 0.05 (Beaton: [0034]).

Per claims 14-23 and 25-35: *The recited box-whisker plot is simply a well-known convenient way of graphically depicting a number summary, which consists of the smallest observation, lower quartile, median, upper quartile, and largest observation (See: CRC, or Wikipedia, for example) and hence would have knowingly been implemented by a skilled artisan in order to graphically depict the summed forces.*

Per claims 36-38: *Ma teaches adjusting bit design parameter (Section 6.1.2.3) and bit parameters (Ma: Chapter 2).*

6. **Claim 11 [Claims 8 and 9] are rejected under 35 U.S.C. 103(a) as being unpatentable under Ma, in view of Glass, further in view of Beaton, in further view of US. Patent 6039131 issued to Beaton (Beaton2 hereafter).**

Regarding Claim 11

Teachings of Ma, Glass and Beaton are shown in the parent claim 45.

Ma, Glass and Beaton do not explicitly teach the ratio of the sum of the radial forces to the applied weight on bit is less than or equal to 0.20.

Beaton2 teaches the ratio of the sum of the radial forces to the applied weight on bit is less than or equal to 0.20 (Beaton2: Col.3 Lines 7-11).

Hence a skilled artisan would have knowingly modified the teachings of Beaton2 with the teachings of Beaton as Beaton2 is Beaton's own work in an analogous field of PDC drill bit design.

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7. **Claims 8 and 9 are rejected under 35 U.S.C. 103(a) as being unpatentable under <u>Ma</u>, in view of <u>Glass,</u> further in view of <u>Beaton</u>, in further view of "Drag-Bit Performance Modeling, <u>Warren</u> et al, SPE Drilling Engineering, June 1989"**

Analogous art Warren renders obvious elements of the present invention relating to simulating the <u>fixed cutter drill bit drilling an earth formation</u>; (pp. 119, col. 1, para:3-7, pp. 126, col. 1, para:2 to col. 2, para:3, Fig. 6) and determining a cutter-formation interaction force, relative sliding velocity, and cutting surface parameters on a cutter of the fixed cutter drill bit (pp. 19, col. 1, para:6, 7, pp. 126, col. 1, para:2 to col. 2, para:3, Fig. 6, Fig. 6).

Motivation to combine Ma with Glass is presented in the parent claim 45.

Motivation to combine Beaton with Glass is presented in the parent claim 45.

Hence a skilled artisan would have knowingly modified the teachings of Ma with the teachings of Warren, motivated using the same reasoning as previously cited above, to model and implement a fixed cutter drill bit. Ma teaches simulation and computation of forces acting on the drill bit (Ma: Section 5.3 "Simulation Test of the crater forming process by bit teeth" and at least on Pg.202 – as shown on previous page). Ma acknowledges that computer aided simulation and display is anticipated (Ma: Pg.207) analogous to the teaching of Warren (Warren: *pp. 126, col. 1, para:2 to col. 2, para:3, Fig. 6, Fig. 6*) and Glass (Glass: *Col.4 Line 58-Col.5 Line 11*).

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Conclusion

1. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

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Communication

Any inquiry concerning this communication or earlier communications from the examiner should be directed to AKASH SAXENA whose telephone number is (571)272-8351. The examiner can normally be reached on 8:00- 6:00 PM Mon-Thu.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Kamini S. Shah can be reached on (571)272-2279. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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